UNITED STATES DEPARTMENT OF AGRICULTURE
Extension Service
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REPORT OF REGIONAL CONFERENCE ON LIVESTOCK AND CROP PEST CONTROL

Chicago, Illinois
June 24-26, 1948

The conference held at Chicago was called by the Cooperative Extension Service in cooperation with the Bureaus of Entomology and Plant Quarantine, Animal Industry, Dairy Industry, Plant Industry, Soils, and Agricultural Engineering, and the Office of Food and Feed Conservation. Three representatives from each of the 12 States in the area attended the meeting. Those present represented various groups interested in livestock and crop pest problems, including entomologists, animal husbandmen, dairy husbandmen, veterinarians, and agronomists from various States and from the United States Department of Agriculture. Workers in extension, research, and regulatory activities were also present.

Mr. Karl Knaus was chairman of the conference. Committees were appointed to prepare a report of the major topics discussed. The discussions, which were informal, covered developments and problems in the animal and crop pest fields, including those in research, control, and extension.

In general, insufficient time was available to discuss all important aspects of the many problems and to prepare detailed reports of the conference. However, rather thorough discussions were held on the control of cattle grubs, lice, flies, several important internal parasites, crop pests, and equipment for the application of insecticides and weed-killing agents.

The report that follows is a brief resume of the conference. The recommendations prepared by the committees were discussed and approved by the group in attendance.

SOME GENERAL STATEMENTS CONCERNING THE NEW INSECTICIDES AND NEW METHODS OF APPLICATION

The days are gone when farmers and cattlemen had to be talked into trying new materials and methods as a result of research. Now they are eager and ready to use anything, whether it has fundamental research behind it or not.

Research has been hard pressed to keep ahead of manufacturers, processors, and salesmen. This has been especially true for the insecticides--DDT, TDE (DDD), BHC, methoxy analog of DDT, chlordane, chlorinated camphene, and pyrethrum-synergist combinations that may be useful in combating external parasites of livestock.

The development of machinery for the application of insecticides to livestock and plants has been phenomenal and revolutionary. However, there is still much research to be done. Work is needed on all kinds of dusting and spraying equipment, including airplanes, ground power, and hand-operated units. Special attention should be given to the development of suitable spray guns, booms, and nozzles. Such problems should be given special attention by manufacturers and research stations.

There are literally hundreds of custom spray operators available to undertake any kind of pest control needed on the farm.

In consideration of the control of flies--horn flies, stable flies, house flies, lice, internal parasites, and other pests on livestock, in barns, and in the home, further research on all the newly developed chemicals is needed.

State entomologists and parasitologists should be responsible for recommendations within their States. Representatives of cooperating industry are urged to comply with such recommendations.

We further urge that processors, distributors, and those who do custom spraying of livestock, buildings, or crops conform to the approved recommendations for each State.

REPORT ON CATTLE GRUB CONTROL

A. Present Research

The Bureau of Entomology and Plant Quarantine reports no new and unpublished developments in control. Rotenone is still the only insecticide effective against grubs.

Benzene hexachloride, chlordane, chlorinated camphene, DDT, parathion, and other new insecticides were tested, with poor results. Various formulations of rotenone (emulsifiable extracts, impregnated dusts) were not as good as ground root. Tests are under way to see if over-all spray with the new insecticides will kill eggs or larvae or discourage oviposition by adults. Research is also under way on internal administration of drugs to kill larvae.

Dr. Gunderson, of Iowa, reported results as follows: 300 pounds--pressure without wetting agent--95-percent control; 75 pounds--50-percent control; dusts--87-90-percent control.

Dr. Severin reported that South Dakota had run weight-gain tests on limited numbers of cattle for 2 years. Five different types of treatment ranked as follows (maximum gain on sprayed cattle--2.47 pounds per day):

Grub-free	- 4, 3
Sprayed	- 1, 1
Dusted	- 5, 4
Currier	- 3, 5
No treatment	- 2, 2

Automatic currying machines gave very poor control in Iowa, South Dakota, Kansas, and Nebraska. Widespread use of DDT on cattle for fly control has caused no perceptible decrease in cattle grub infestations.

B. Distribution

Hypoderma lineatum - apparently over practically the entire United States.

Hypoderma bovis - spreading over the United States. It is common in [illegible]ern States and has been reported from Oregon, Idaho, Nevada, Utah, California, Tennessee, Missouri, Virginia, and North Carolina. In South Dakota it is more abundant than Hypoderma lineatum.

C. Control Practices

Where only Hypoderma lineatum occurs, two or three treatments have been recommended. South Dakota set up an area test involving 6,500 head of cattle sprayed four times (began February 10-15). County agents report very little fly activity where isolated herds were treated four times, but much fly activity when three treatments were made. The activity was possibly due largely to Hypoderma bovis. Where both Hypoderma lineatum and Hypoderma bovis are present, five treatments will probably be needed.

High-pressure sprays ranging from 250 to 600 pounds are most widely used. Dusts and washes are employed to a lesser extent.

D. Cattle Grub Legislation

Dr. H. R. Smith, of the National Livestock Loss Prevention Board, reported that Congress had passed a bill authorizing appropriations for area clean-up demonstrations and for research. Although funds have not yet been appropriated, they are expected to be available by January 1, 1949. It was the opinion of the group that clean-up could start with 90-percent cooperation of the livestock growers, but that more complete cooperation should be the goal.

Several States already have a start on area clean-up. Nebraska, Kansas, and Iowa have one or more counties treating 85 to 97 percent of the cattle now. These percentages represent the number receiving one or more treatments. Dr. Foster, of the Bureau of Animal Industry, reported that in a 100- square-mile area in Colorado where intensive control was carried out there was a reduction of 70 percent in infestations after one year, and 85 percent in two years.

Dr. Kelly, of Kansas, remarked that reinfestation occurs through shipped-in grubby cattle. This points up the need for wide cooperation between States. The group stressed the need to use money for concentrated work in small areas.

E. Needed Research

1. Effect of wetting agents on sprays applied at various pressures.

2. Long-range weight gains and milk production records following grub treatment.

3. Detailed studies on the physiology of cattle grubs and their effect on the host.

4. Research to find and develop better methods of grub control.

F. Recommendations

1. Intensive educational program.

2. Control program on beef cattle: Mass treatment by power equipment at 30-day intervals as long as grubs are present in the back. Use 7½ pounds 5-percent rotenone (finely ground root) per 100 gallons water at 250 pounds to 600 pounds pressure.

   Control program on dairy cattle: On small herds, probably hand dusting or washing is most practical. Apply treatments at intervals of 25 to 30 days as long as grubs are present in the back. Dusts should contain 1.67-percent rotenone. The 5-percent ground root (or equivalent) should be diluted with pyrophyllite or tripoli earth, at the rate of 1 part plus two parts of the diluent. The wash should be prepared by adding 12 ounces of 5-percent rotenone plus 2 ounces of soap to 1 gallon of water.

3. States that raise infested cattle for export should be encouraged to carry out intensive area control or clean-up, so that cattle from those States will not ruin work done in other States.

REPORT ON LOUSE CONTROL

A. Current Research

1. Hog Lice

Spraying hogs with 5-percent concentrations of DDT or technical BHC has given control according to the Bureau of Entomology and Plant Quarantine. All the chlorinated organic compounds in limited number of tests gave control of motile forms of lice at 0.2-percent concentrations. Tests have been conducted with DDT, BHC, chlordane, chlorinated camphene, TDE (DDD), and the methoxy analog of DDT. However, the 0.2-percent concentration will not provide complete control, except possibly with chlordane and chlorinated camphene. Further tests with the different insecticides are needed.

2. Sheep and goat lice

Dipping--Apparent complete control of biting lice on goats was obtained by 0.2-percent dips prepared with the chlorinated hydrocarbons previously

mentioned. Chlorinated camphene, in general, has proved most effective, giving apparent complete control in some tests at 0.05-percent concentration.

c. Cattle lice

a. Representatives of several States reported that adequate louse control was not obtained by the ordinary DDT applications made for horn fly control.

b. The Bureau of Entomology and Plant Quarantine reports that one treatment with 0.5-percent concentration of the different chlorinated hydrocarbons, either emulsions or wettable powders, gave good control where the animals were wet thoroughly. BHC, in general, seems most effective, Pyrethrum at 0.005-percent concentration and piperonyl butoxide at .1 percent killed motile forms but did not give complete control with one treatment.

B. Recommendations for Controlling Cattle Lice. (See report on other external parasites for lice on other livestock.)

1. A thorough treatment with 0.5-percent DDT wettable powder in water (8 pounds of 50-percent wettable powder for 100 gallons of water) is recommended as a dip or spray for control of cattle lice. The wettable is recommended in preference to emulsions.

2. A thorouch application at the time of the last treatment for horn flies is suggested. Particular attention should be given to wetting such areas as the brisket, ears, tail, and underline.

3. A 10-percent DDT dust, 6 to 8 ounces of dust per animal, may be used. A second treatment about 3 weeks later is required.

4. Rotenone is also recommended for control of cattle lice, when employed as a dip or spray, as follows:

As a dip use the old standard of 10 pounds of 5-percent cube or derris powder and 100 pounds of a 325-mesh wettable sulfur to each 1,000 gallons of water. Two applications at 14- to 18-day intervals are necessary.

As a spray, use the same concentration employing 1 pound of 5-percent cube or derris powder to 100 gallons of water for power sprayers. Make 2 applications 14 to 18 days apart.

5. BHC is effective but is still in an experimental stage. If it is employed, restrict its use to beef animals (not including small calves) and at concentrations not to exceed 0.05-percent gamma isomer or about 0.5 percent of technical BHC, employing wettable powders only. If young calves less than 3 months old are treated do not exceed .025-percent gamma isomer spray or dip.

REPORT ON FLY CONTROL

A. Current Research

1. Horn flies

Dr. Knipling reviewed briefly the results of recent studies to determine the relative effectiveness of various new materials for fly control. Studies on horn flies were conducted during 1947 in Kansas and Missouri in cooperation with the experiment stations and extension services in those two States and with the National Livestock Loss Prevention Board. Tests were also conducted on herds in the vicinity of Kerrville, Tex.

Good control of horn flies employing wettable powders at 0.5-percent concentration was obtained with DDT, TDE, chlorinated camphene, chlordane, and the methoxy analog of DDT; however, some were indicated to be slightly more effective than others. DDT and chlorinated camphene in general were most effective and gave about the same results. Chlordane, which was tested less extensively, was slightly inferior to DDT when used at 0.25-percent concentrations. TDE and methoxy analog of DDT in general were about equal and somewhat less effective than DDT. Although the effectiveness of treatments varied in different localities, about 1 month's protection resulted with DDT and chlorinated camphene. TDE and methoxy analog of DDT were effective on the average for about 25 days. No significant difference has been shown in the effectiveness between wettable powders and emulsions employing DDT or the other insecticides.

Dr. Kelly discussed the Kiowa County county-wide horn fly test under way in Kansas. This large-scale horn fly control demonstration project is being carried out jointly by the Kansas Experiment Station and Extension Service, the National Livestock Loss Prevention Board, and the Bureau of Entomology and Plant Quarantine. Practically all cattle and barns in Kiowa County were treated with DDT for fly control. The test has not progressed sufficiently to determine results, but a united effort in the treatment of cattle seems to be definitely advantageous in prolonging the effectiveness of a single DDT treatment for controlling horn flies.

2. Other flies

No outstanding new developments in controlling tabanids was reported. The variation in results reported by different workers when BHC and other insecticides are applied to livestock for tabanid control was discussed. In some cases treatment with these materials seems to offer fairly satisfactory results, but in others they have been of little value. In the Southeast, BHC and methoxy analog of DDT or combinations of the two have shown considerable promise. The pyrethrum-piperonyl butoxide combination has also shown promise for temporary protection. DDT is still the outstanding residual insecticide for flies in barns. The methoxy analog of DDT is probably the next best material for this purpose according to studies reported by the Bureau of Entomology and Plant Quarantine.

All members present recognized the need for more research with the various new materials and other methods of control for flies, especially the tabanids.

B. Recommendations

1. In view of the questions that have arisen regarding toxicity hazards of DDT in milk, the committee urges that minimum amounts of DDT be applied to dairy cows consistent with satisfactory fly control. Concentration and amounts of DDT to apply should be in accordance with State recommendations. Available information on the toxicology of the methoxy analog of DDT suggests that this material is of a low order of toxicity to warm-blooded animals. Studies conducted thus far also indicate that little or none of the insecticide when applied to dairy animals is secreted in milk. Therefore, if toxicologists conclude that DDT in milk is hazardous to the health of man or animals the committee suggests the methoxy analog of DDT as a possible substitute for the control of horn flies on dairy animals.

2. The continued use of DDT, thoroughly applied to buildings and other places where flies rest, is recommended for house fly and stable fly control. Sanitation to reduce breeding areas should be practiced and stressed as a necessary adjunct to chemical control.

3. DDT and some of the other new insecticides have not been found to be effective in the control of horse flies and deer flies for more than a few days. Under certain conditions this seems to reduce the severity of these insects; however, no general recommendations can be made at this time.

4. In treating cattle for fly control it is urged that one thorough treatment be made in the fall to control lice following recommendations outlined under louse control.

REPORT ON MEDICATION FOR INTERNAL PARASITE CONTROL

Inasmuch as most materials used in controlling and elimination of internal parasites in livestock are a poison, the amounts required to expel the parasites and yet not harm the animal should be known. Proper methods of dosage and recommended amounts must be adhered to for optimum results.

A. Phenothiazine for the Removal of Worms in Cattle, Horses, and Sheep

Phenothiazine is the most used of all worming agents in the livestock field.

1. Cattle

The drug of choice for the removal of stomach and intestinal roundworms is phenothiazine. The dose is 20 grams per hundredweight, the total dose not to exceed 60 grams, administered in capsules or boluses, as a drench or in feed. Probably the best control comes from treating calves, yearlings, and 2-year olds immediately before each grazing season. Caution: The drug should not be given to dairy cows on account of an excretion of a dye in the milk. Mature cattle rarely suffer from parasitism.

2. Horses

Phenothiazine is the most effective drug known for controlling strongyles. Horses, however, are somewhat susceptible to intoxication. Constipation must be guarded against. Animals should be on an adequate protein and adequate calcium diet.

Dosage: Dosage of 30 grams for animals of average size is safe and may be given by the method of preference. The safest method consists of giving 5 grams daily in the feed for 6 days.

For most effective control of strongylosis, animals may be treated once each season before being put on clean pastures.

Young stock may be given a first treatment at 6 to 8 months of age.

3. Sheep

The most useful drug for controlling gastrointestinal roundworms in sheep is phenothiazine.

Dosage: Doses of 25 grams (about 1 ounce) are used for adult animals and 15 grams (about 1/2 ounce) for lambs under 60 pounds. Treatment may be given in capsules, boluses, as a drench, or in feed.

The free choice of a mixture of 1 part phenothiazine (by weight) in 9 to 14 parts of salt (by weight) is an effective control measure. Weekly salting with 1 part of phenothiazine and 7 parts of salt may be useful where weekly salting is practiced.

Caution: Ewes should not be treated during the last month of pregnancy.

From the research standpoint, the most important practical problem concerning the use of phenothiazine in horses and cattle is the possible application of the method of free choice administration in salt or mineral mixture. The best free choice mixtures appear to be those that contain about 4 percent phenothiazine (instead of 10 percent) in loose salt or mineral mixtures. Such mixtures may be kept before grazing animals (horses and calves) almost indefinitely without intoxication. The method effectively controls parasitism in 75 to 90 percent of the animals; it should be employed only when the user assumes the responsibility of seeing to it that the system is effective in individual cases.

B. Removal of Roundworms in Swine

To date sodium fluoride is the most effective worming agent for removing roundworms from swine. Oil of chenopodium is about 75 percent effective, phenothiazine about 50 percent effective, and sodium fluoride 95 percent effective.

Sodium fluoride has all the advantages of ease of administration that phenothiazine has, plus nearly twice the efficiency.

Dosage: The chemical is administered in dryground feed at a concentration of 1 percent for 1 day. Extensive experience to date indicates that this is a safe, effective, simple, and economical method of medication. One pound of sodium fluoride should be mixed with 99 pounds of dry ground feed. This treated feed should be fed as a dry feed for a period of 1 day. To control roundworms, growing pigs should be treated once after weaning and a second time about 2 months later.

Caution: Do not starve pigs the day before feeding treated feed. Be sure the feed is well mixed and fed in a dry feed. Do not treat pigs that are scouring or sows that are pregnant.

Milk fed to the extent of producing a diarrhea will expel worms in swine. Milk can be fed for 3 successive days or fed once a day for 3 weeks.

LEAD ARSENATE FOR THE REMOVAL OF TAPEWORMS IN SHEEP

Tests on about 4,000 animals showed that doses of 1/2 to 1 gram of lead arsenate were well tolerated by lambs, that such doses removed tapeworms, and the result was beneficial to the health of the treated animals.

The treatment must be regarded as in the experimental stage. Further information is needed on the occurrence of lead and arsenic in the tissues of treated animals (these are dangerous elements in human foodstuffs) and on the need of lead and arsenic in the molecule.

REPORT ON OTHER EXTERNAL PARASITES

A. Screwworms

Smear 62, as developed by the Bureau of Entomology and Plant Quarantine, is available and should continue to be used against screwworms. Smear 82 is equally effective. These treatments should be applied to wounds of uninfested animals to prevent infestations. Wounds should be treated twice a week until healed.

In addition to chemical control of infested stock on farms, emphasis should be placed on inspection and treatment of infested animals shipped from infested areas.

B. Fleeceworms

The fleeceworm treatment still recommended by the Bureau of Entomology and Plant Quarantine consists of:

10 percent diphenyl.
1 percent triton x 70.
5 percent N-butyalcohol.
84 percent benzol.

Research indicates that several of the new chlorinated insecticides at a concentration of 2 percent are superior to 10-percent diphenyl in protecting animals from reinfestation. Among these are BHC, DDT, chlordane, and chlorinated camphene.

C. Lone Star Tick

The Bureau of Entomology and Plant Quarantine reported that DDT sprays at concentrations of 2.5 percent or lower are not completely effective against engorged forms of the lone star tick, but concentrations as low as 0.75 percent thoroughly applied will kill flat stages and will provide 2 and 3 weeks' protection against reinfestation. However, benzene hexachloride at a concentration of 0.025-percent gamma isomer kills all stages of ticks. Research results indicate a kill of all stages and 2 to 3 weeks' protection when animals are treated with 0.75-percent DDT in combination with 0.025-percent gamma isomer BHC. At present, BHC or combinations of this insecticide with other materials are still considered in the experimental stage. Any use of BHC at present should be restricted to animals (avoid treating young calves) not producing milk for human consumption. Chlorinated camphene and chlordane are more effective than DDT in killing the lone star tick but their use is not recommended at this time because of possible toxicological effects.

Ticks in grassy areas - The control of ticks on grass, shrubs, trees, and in camping areas may be obtained by using 2 to 3 pounds of technical DDT, chlordane, or chlorinated camphene per acre applied as a spray or dust to margins along paths and grassy areas where infestations exist.

D. The Winter Tick

The winter tick shows about the same degree of resistance to the insecticides mentioned as does the lone star tick. However, the same materials provide much longer protection against reinfestation. DDT sprays containing from 0.5 to 0.75 percent DDT will protect animals from reinfestation for about 1 month. Although their use is not recommended at this time, chlordane and chlorinated camphene at similar concentrations will protect for about 2 months.

E. Brown Dog Ticks

Good control of dog ticks can be obtained with DDT treatment of infested premises and on animals. Building treatment requires thorough coverage of walls, baseboards, and casings with 5-percent DDT in an odorless kerosene and a 10-percent DDT powder blown into cracks. On dogs a 10-percent powder is effective if repeated treatments are made, though engorged ticks possess more resistance to the material than flat ticks. Benzene hexachloride rapidly kills all stages but does not have prolonged residual effect. One percent rotenone in the dust or wash is also effective against ticks on dogs.

F. Sheep Tick (Keds) and Sheep and Goat Lice

Research has revealed several materials effective against sheep ticks and sheep and goat lice: (1) Rotenone dip at the rate of 1/2 pound of 5-percent rotenone-bearing powder (ground root) per 100 gallons of water is highly effective and the most economical treatment; (2) DDT dip prepared as emulsion or suspension at a concentration of 0.2-percent DDT is also highly effective; (3) BHC dip at the rate of 0.025-percent gamma isomer. A single treatment with any of these results in complete kills and suggests the possibility of complete eradication.

When dipping is not considered practical, spraying or dusting may be used. A 0.5-percent DDT spray, properly applied with a power sprayer, has produced good results. Rotenone dust containing 0.5-percent rotenone applied with a power duster has also given satisfactory results.

G. Sheep Scab

Nicotine and lime sulfur are the only official recommendations for sheep scab, and quarantine regulation remains an essential for control. Experimental work with benzene hexachloride indicates that it is very promising for scab control.

H. Hog Lice and Mange

1. Spray with 0.5-percent DDT when lice appear, using 8 pounds of wettable powder to 100 gallons of water. One thorough treatment is sufficient.

2. Benzene hexachloride can also be used effectively for the control of hog lice at a suggested concentration of 0.25 to 0.5 percent technical or 0.025 to 0.05 percent gamma.

BHC is also effective against mange but should not be used in excess of 0.25-percent gamma isomer. It should not be applied later than 60 days prior to marketing or less than 30 days prior to farrowing.

3. Crankcase oil will also control lice and mange. Chlorinated camphene and chlordane have been used successfully but are still experimental.

I. Sheep Head Bot

Control of sheep head bot is obtained by injection of a 3-percent aqueous lysol solution into the nasal passages under pressure (see references for procedure and equipment.)

J. Poultry Lice

1. Sodium fluoride, 1 ounce to 1 gallon of water should be used as a dip (pinch method used in cold weather).

2. DDT as a 5- to 10-percent dust is also effective.

Poultry ticks and mites: Treat house, roost, nests, and posts with residual application of DDT (5 percent in kerosene or as an emulsion or 2½-percent wettable powder) for control of ticks, bedbugs, mites, fleas, and flies.

K. Mosquitoes

The use of recommended applications of DDT for buildings and livestock will aid in the control of mosquitoes.

EQUIPMENT

Power spray equipment for farm use is of two general types, namely the low-pressure type commonly used in weed control, and the piston-type sprayers commonly used in orchard spraying.

The gear-type equipment is designed for low-pressure and low-volume spraying, and many of the units now being manufactured are attached to the power take-off of tractors. Thousands of such units are now being used on farms throughout the Middle West.

It was generally agreed that the conventional piston-type sprayers had ample pressure and were suitable for all types of weed and insect control work. Such machines have the disadvantages of being expensive, cumbersome, and difficult to transport from place to place. Another factor to be considered is the difficulty of removing 2-4,D residues, especially from wooden tanks, if the machine is to be used for spraying crops susceptible to 2-4,D injury. For these reasons, it was thought that no one type of sprayer was entirely satisfactory and practical for both weed and all types of insect control.

Some workers reported satisfactory fly control on dairy cattle and in buildings with gear-type equipment, but it was agreed that at least 400-pounds pressure was necessary for most satisfactory cattle grub and sheep tick control. Pressures higher than those normally obtained from the gear pumps is also desirable for spraying range cattle, mainly because of the time element involved. It was pointed out that the abrasive materials in wettable DDT powder seriously affected the gears of some low-pressure units, and the emulsifying agents in oil emulsions might adversely affect those units that had rubber-type gears.

In insect-control work, the gear-type sprayer will operate with less difficulty if coarse straining screens are used. There is considerable research under way involving the use of concentrates for insect control. If such materials prove effective, they will increase the use of low-pressure equipment, especially against field crop insects.

In view of these factors, it would be best for the farmer to recognize the need for both types of equipment until all-purpose units are developed. Purchasers of equipment should carefully study the uses to which the machine will be put and acquire equipment that will most nearly fulfill these needs. In the absence of farmer-owned equipment, custom spraying may well serve a useful purpose in solving specific problems.

The group strongly recommends a well-planned and intensive research program to develop suitable equipment for various types of farm spraying. Such research should include a study of pumps, motors, nozzles, and screens and should be carried on in cooperation with persons having a good knowledge of the engineering principles involved.

GENERAL STATEMENTS ON THE TOXICITY OF INSECTICIDES

The toxicity of the new chlorinated compounds to animals and especially to human beings who consumes the meat or milk from such animals must be considered in connection with their use. Thus far, relatively few cases of harmful effects to livestock have been observed where the chemicals were used according to directions and in the minimum amounts adequate for insect control. In addition, no authenticated cases of toxicity to human beings are known, after the use of any of the chlorinated compounds to control insects. Chlorinated camphene in the hands of stockmen has killed young calves when used for livestock pest control. Experimentally, toxic symptoms have been produced in young calves receiving a single thorough treatment with a 1.5-percent spray, whereas older animals have shown no toxic effects when treated a number of times with even higher concentrations. Chlordane has killed cattle that were thoroughly treated with 2-percent spray at 2-week intervals, which is considerably in excess of that needed for controlling various pests. However, insufficient information is available to determine possible adverse effects at lower concentrations.

Even though in most cases the chlorinated compounds have had no evident detrimental effect upon livestock, nevertheless it is known that the insecticides or some related products are deposited in varying amounts in the fatty tissues or butterfat of treated animals. The amounts deposited in animal tissues when the insecticides are employed in quantities needed for pest control have not been determined. Studies have been conducted to determine the amounts of insecticides secreted in the milk of dairy animals treated for horn fly control. It is known that DDT and TDE are secreted in milk in small quantities. In the case of DDT the amounts are about the same whether wettable powders or emulsions are applied. The possible critical health hazards of these deposits and secretions to human beings are not yet known. Apparently, concentrations of some of the chlorinated compounds in meat and milk persist for a considerable period and are dissipated gradually after the animal is treated or is taken off insecticide-treated feed.

Of the materials that have been tested, methoxychlor has produced the least accumulations of organic chlorine in milk. The amounts of chlorinated camphene, chlordane, and benzene hexachloride secreted in milk have not been definitely established.

There have been reports of off-flavor in meats caused by the use of benzene hexachloride on animals. Few, if any, of the cases can be authenticated when the insecticide has been used in amounts necessary for controlling livestock pests. However, more taste tests of meats from various classes of animals treated under diverse conditions must be made before definite statements can be made in this respect.

In general, it may be said that much additional research is needed on the toxicology of the various new insecticides. More information is needed in particular to determine the relative susceptibility to insecticides of different age groups of various kinds of livestock, chronic effects of repeated treatments of low concentration, toxicity of different types of formulations, amounts of insecticides stored in animal tissues and secreted in the milk, and possible tainting of animal products from treated animals. In view of these many complicating factors it seems desirable to move slowly in recommending new materials for general use in the livestock pest field, even though some of them are known to be highly effective for controlling livestock pests.

INSECTS ATTACKING FIELD CROPS

A. European Corn Borer

A review of the general recommendations of the Peoria conference, subject to local area modifications, was generally accepted by the group. Since these recommendations are now in the hands of all entomologists concerned and are also available to others on request to W. G. Bradley, Toledo, Ohio, or to the Bureau of Entomology and Plant Quarantine, Washington 25, C. D., they are not included in this report.

The office for Food and Feed Conservation's program on the European corn borer was developed to supplement State facilities and endeavors on educational and demonstrational procedures in the four States most seriously involved--Illinois, Iowa, Minnesota, and Wisconsin. The consensus of those present was that this and other phases of the OFFC program were of material aid in meeting problems of each State as encountered.

The committee recognizes that the full damage potential of the European corn borer may not be realized this season. Even so, results obtained to date indicate the value of an enlarged educational program in acquainting farm operators with adequate means of determining individual corn borer problems and the associated need for control procedures. This provides effective conservation and adequate distribution of insecticides throughout the area and also gives farmers confidence in similar entomological procedures for the future.

Brief discussions among the group covered a progress report on studies in varietal resistance to the European corn borer, cultural practices, and local experiences in insecticidal control.

B. Alfalfa Insects

The Alfalfa weevil appears to be moving eastward out of the Black Hills area of South Dakota, where it has been established for some time. Severin reports effective control with either toxaphene or chlordane as used for grasshoppers.

With regard to other alfalfa insects, a question regarding the use of low-volume, low-pressure sprayers remained unanswered. Kelly reported good control of webworm by the use of 2 pounds each of DDT and BHC in 50 gallons of water per acre. Nebraska results against webworm and lygus bug were satisfactory with 20 to 25 pounds of 10-percent DDT dust. Kelly reported briefly on a Kansas station study, which indicated that alfalfa plots sprayed with DDT showed much more uniform blossoming, with the bloom completed in 16 days, as compared with almost continuous bloom on unsprayed plots.

Michigan recommends 1½ pounds of actual DDT per acre on alfalfa, but Jones cautioned that seed yield increase will vary greatly, depending on varying insect infestations.

Gunderson reported excellent yield increases of alfalfa seed from spraying, but poor or inconsistent increases on red clover in Iowa. Sooter observed that adequate pollinating insects were a most important item and that careful use of insecticides appeared to be relatively noninjurious to pollinators.

Parks reported extensive damage from clover root borer in Ohio, but that fall applications of DDT provided effective control for the following season.

Caution in washing 2,4-D from sprayers was advised by Strahler. The use of distillate, soapy water, and thorough rinsing are indicated. 2,4-D probably cannot be cleaned from wooden tanks in a satisfactory manner to permit the use of the machine on susceptible crops such as beets or tomatoes.

C. Chinch Bugs

Infestations of chinch bugs are generally not important this season. Bugs were very abundant in Kansas early in the season, and there was heavy egg deposition on barley. However, timely rains practically eliminated them just after hatching. Preparations for barrier construction were made, but were not generally needed. Quisenberry reported promising results in the development of varieties of barley and sorghum resistant to chinch bug.

D. Hessian Fly

The Mida variety of hard spring wheat shows excellent resistance in North Dakota, but not in Wisconsin. Likewise, Pawnee winter wheat is reported widely grown and very resistant in Kansas, except in the southeastern counties. Pawnee is not too resistant in Iowa. These differences appear to be due to different strains of the insect.

Volunteer grain in legume seedings serves as host reservoir and complicates control. Winter barley, requiring early seeding, is also a favorable host and complicates delayed seeding recommendations. Resistance studies are continuing, with several varieties of winter barley showing marked resistance. Sources of resistance for all strains of the fly now

appear available. Incorporating these various resistance factors into acceptable varieties is a major endeavor now under way.

E. Grasshoppers

Gunderson reported hoppers abundant, especially in the south half of Iowa. He is planning no baiting program, but recommends farmer purchase of effective insecticides for crop protection. This can be accomplished with reasonable cost if applications are made early to concentration areas.

The consensus is that chlordane and toxaphene give excellent hopper control if used as recommended. (See Bureau of Entomology and Plant Quarantine Circular EC 1, 1948.)

A question regarding the use of 2,4-D and chlordane together on roadsides for weed and grasshopper control was unanswered. The committee recommends general trial of this combination in appropriate localities.

F. Stored-Grain Insects

There is normal heavy farm storage in Ohio, and Parks recommends timely treatment of empty bins with DDT emulsion before harvest. He thinks this will greatly reduce the necessity of later fumigation. Both inside and outside of bins should be treated, using 5-percent strength.

Recommendations given in the OFFC fact sheets on this problem have general approval. Emphasis should be placed on storage of dry, dockage-free grain to reduce insect problems. Also fumigation procedures must be accomplished under high temperature conditions.

G. Miscellaneious Items

Briggs reported a localized wireworm problem in Wisconsin, especially in oats.

Gunderson reported 150,000 acres of corn destroyed in Iowa by cutworms (black cutworm is the major species). Damage is most severe in low areas that were flooded out last year and overgrown with grass and other vegetation. Younger worms are well controlled with 2 pounds of DDT per acre, but older worms are not controlled with DDT, chlordane, BHC, or poisoned bait.

White grubs (controlled with 5 pounds actual DDT per acre) were briefly discussed. Webworms (not controlled satisfactorily with newer insecticides) and spittle bugs on legumes were discussed also.

The report was prepared after the adjournment of the meeting, and no opportunity was available for presentation to the group for approval. Omissions and errors are due to inadequate notes available to the committee.

WEED CONTROL

A. Discussion by L. M. Stahler, Agronomist, Bureau of Plant Industry.

1. Pre-Emergence Treatments With 2,4-D and Other Herbicides.

In general, experimental pre-emergence treatments with 2,4-D at the various stations this season offer very little encouragement for any recommendations that can be made for next year. Rates of application from 1 to 3 pounds of 2,4-D acid per acre have in general given little or no weed control and also in general have shown no injurious effects on the corn. Elder, of Oklahoma , had definite injury to the stand and vigor of corn on his pre-emergent treated plots with little or no weed control in evidence. Buchholtz, of Wisconsin, has an extensive investigation under way and the only evidence of weed control on his plots was indicated for those treated with the esters of 2,4-D. You will recall that in the past we felt that there was no advantage in any one of the 2,4-D formulations as a pre-emergent treatment but there is slight evidence this year at several locations that the esters of 2,4-D may give slightly better results in weed control under the conditions that existed this year. This does not mean, however, that we are in any position to recommend the esters over the sodium salts and amines when used as pre-emergent treatments on corn, as the evidence this year is only fragmentary and cannot be interpreted in any way as dependable over a period of years. In fact the reactions observed in both weed control and damage to corn this season will illustrate the uncertainties that we will have to expect in any use of 2,4-D as a pre-emergence treatment for the control of weeds in corn. Over most of the area observed, the early spring season has been very dry and has limited the growth and germination of weeds as well as of corn. In a few areas where normal precipitation was recorded this season we are getting a few reports of fair to good weed control in corn where pre-emergence treatments with 2,4-D at rates of application of 2 to 3 pounds were used, with damage to the corn reported as zero to heavy.

Investigations of the use of 2,4-D as a pre-emergence treatment to control weeds in flax, oats, barley, wheat and soybeans likewise indicate that we will be in no position to make any recommendations for field use of this method for 1949. In fact, results so far this season will make us more cautious than we were in 1948. As an example of the uncertainties of 2,4-D as a pre-emergence treatment, we observed plots of onions at Madison, Wisc. which were growing on upland and on muck soil, respectively, but which had had comparable applications with 2,4-D as a pre-emergence treatment. On the upland soil the stand of onions was greatly reduced by all rates of application of 2,4-D, while on the muck soil only excessively high rates of application resulted in any reduction in stand. Set onions on upland soil were heavily injured by all rates of application tested, whereas on muck soil little damage was in evidence from any rate of treatment tested. Plots on the upland and muck soil were closely adjacent, and several inches of rain fell on these plots within a few days after seeding and retreatment. I mention this example to illustrate the effect of soil type on the outcome of pre-emergence treatments. I want to emphasize that rainfall following the application of 2,4-D as a pre-emergent treatment--an uncontrollable factor--generally is a more important consideration than the amount of 2,4-D

used per acre in determining the results of the treatment. It is apparent that even the most optimistic investigators are going to be reluctant to make any recommendations for the use of 2,4-D as a pre-emergence treatment in weed control when the results of the many investigations being conducted this year are summarized at our annual weed conference this fall.

Other herbicides such as the dinitros, pentachlorophenols, various petroleum fractions, TCA, and cyanamids are being widely investigated as pre-emergent treatments this season, and to date there is little evidence that any one of these compounds will offer much that we can use in recommendations in 1949. The dinitros offer some possibilities in use.

2. New Herbicides

You are undoubtedly interested in getting information on some of the newer herbicides that have received some publicity in the past year. Of these 2,4,5-T (2,4,5-trichlorophenoxyacetate) is being widely tested for control of brushy species and for herbaceous perennials such as leafy spurge. To date there is little evidence that this material is greatly superior to the ester of 2,4-D in the control of leafy spurge, but there is some evidence that it has possibilities for the control of some of the woody species that have been quite tolerant to 2,4-D. The various species of the bramble or Rubus--blackberry, raspberry, and the like appear to be less tolerant to 2,4,5-T than to 2,4-D, and considerable research is being done this season to establish the possibilities of the use of this material for controlling these hertofore resistant species. There is some indication that 2,4,5-T is slightly less toxic to winter wheat than the esters of 2,4,-D, and it may have some possibilities in use in the control of annual and perennial weeds in this crop. The herbicide 2,4,5-T is generally formulated as an ester. It is not widely available commercially but is being used extensively in some areas this season by commercial operators in the control of brushy, woody plants under power and communication lines along highways.

TCA (trichloroacetate), formulated as a sodium or amine salt, is not available commercially but is being supplied to investigators by several commercial companies. Investigations to date indicate that this material may be valuable in the control of quackgrass, Johnson-grass, Bermuda-grass, and some of the less noxious annual and biennial grasses. Throughout the area investigators report good control of Johnson-grass and Bermuda-grass with 100 to 150 pounds of TCA per acre. Seldom is complete elimination obtained and spot re-treatments are the general rule. Bermuda-grass treated with 100 pounds per acre has been completely eliminated in investigations being conducted at Manhattan, Kans., Stillwater, Okla., and other stations in the area. TCA has proved very efficient in the elimination of Opuntia cactus and Yucca--both species having been resistant to previously tested herbicides. Preliminary investigations, particularly in Nebraska, indicate that TCA at rates of 8 to 20 pounds per acre applied in the fall may be used to control weedy grasses in brome seed fields. Extensive investigations are under way to determine the possibilities of use of TCA for the control of grassy weeds in sugar beets--the latter being somewhat tolerant of moderate rates of application of 2,4-D.

The cost of TCA to the ultimate consumer has not yet been established, but we cannot hope that this material will be as cheap in use as 2,4-D. The residual effect of TCA in soil is relatively short-lived--from 3 weeks to 3 months, depending on moisture and soil temperatures.

IPC (iso-propyl-n-phenylcarbamate), which has been widely tested in comparison with TCA, has in general shown little to recommend it for the uses previously discussed. There are some reports of successful use of IPC in the control of grassy weeds in sugar beets.

Fortified oils--various fractions of the distillation of petroleum with a high aromatic content--are being widely tested for the control of weeds in specialized horticultural crops and for the control of undesirable grassy weed seedlings. These oils are used either straight or fortified with pentachlorophenols or dinitro compounds. The aromatic oils and oils fortified with dinitro compounds have attained wide use in the Western States, but in this area their use is still in the experimental stage. When fortified with dinitros or pentachlorophenols, some of the oil fractions are especially "hot," giving a quick kill of all green foliage, and may be adapted to control weedy grasses such as brome, goatgrass, and wild barley along roadsides, fence lines, and elsewhere.

The dinitro compounds are of two types, the selective materials used for the control of broad-leaved annual weeds in flax, peas, and small grain--such as Sinox-W and Dow Selective. These materials have lost considerable ground to 2,4-D in the control of broad-leaved annuals in small grains and flax but are yet highly popular for the control of these weeds in peas or in small grains and flax where legumes are seeded as a companion crop--the legumes being tolerant of recommended rates of application. The more concentrated dinitros, Sinox General and Dow General applied in oil are widely used on the west coast for quick, unselective elimination of all types of undesirable herbage but to date have very limited use in this area. Investigations under way at several stations, particularly at Nebraska, show promise in the use of the dinitro compounds for the control of weedy grasses and winter annual broad-leaved species in fields seeded with grass and alfalfa.

3. 2,4-D

A tremendous acreage is being treated this year with 2,4-D for the control of annual and perennial weeds in growing crops. The many thousands of new low-volume sprayers being used, all of which have certain undesirable factors, have led to a lot of difficulty in field application. Many of the materials, particularly the amines, are causing trouble by the clogging of screens and nozzles when applied in hard water.

Field results of farm application have been spotted because of the generally dry soil. Weeds have not been growing vigorously and therefore have been tolerant of or resistant to 2,4-D at the lower levels of application being used especially in flax. The crops growing under these dry conditions have in general been also especially tolerant of 2,4-D. In many cases where excessive rates of application or poor methods of application have been used, damage to the crops has been averted by the resistant

condition of the crop plants this season. Many operators are doing a poor job of application, not knowing the amount that they are applying and being generally confused by the diverse recommendations and suggestions of commercial manufacturers and particularly the salesmen of the manufacturers. There have been some scattered reports of injury to flax as the result of 2,4-D treatments, but in general we have not observed much real damage.

Airplane application of 2,4-D for the control of weeds in growing crops promises big business. Although much of the work observed has been good, many fliers new to it are doing a sloppy, haphazard job of application. Many of the States in this area and their Civil Aeronautics Administration organizations are getting together to limit and control the application of herbicides by planes in coming years. Planes are applying from 1 quart to 5 gallons of either oil or water solution and in general favor the ester formulations.

B. Dr. Karl Quisenberry, Bureau of Plant Industry.

Dr. Quisenberry reported that the Civil Aeronautics Administration had recently announced a regulation prohibiting the application of 2,4-D dust by planes. The Bureau of Plant Industry has recently completed extensive tests on methods of application of 2,4-D as a spray solution by airplanes using various types of equipment and flying at different heights, flying various width swaths and under varied weather conditions. He indicated that particular attention was paid to determination of the distance to which 2,4-D would drift when applied by plane under the various conditions being studied. As an example he indicated that in a flight at 20 feet across a 5- to 7-mile wind, a drift of 1,350 feet had occurred, and that tomato and cucumber seedlings were affected at this distance from the center of application. He indicated that it was evident from their tests that few fliers actually knew how wide a strip they were applying. Results of the investigations recently conducted will be made available when completely assembled and should do much to clear up the diverse opinions on the subject of airplane application of 2,4-D.

Dr. Quisenberry urged that all people concerned with the weed-control program, both in research and in extension, emphasize the cautions that should be observed in the use of this material. He mentioned the Thomas Resolution entered in the recent Congress, which concerned the publication of cautions in the use of 2,4-D by the United States Department of Agriculture.

Dr. Quisenberry, in indicating the wide and growing interest in weed research and weed control, stated that a southern weed-control conference had recently been organized and that all four of the recognized regions in the United States were now organized into weed-control conferences. He asked that those in charge of organizing the programs of the various regional meetings take into consideration State or regional meetings that might conflict and prevent the attendance of extension research or regulatory workers.

C. Oliver C. Lee, Extension Agronomist, Purdue University.

Lee made the following observations as a result of his work in Indiana:

1. Last year, pre-emergence treatments were, in general, good. This year, the treatments gave good control of weeds where applied very early with sufficient moisture; but, in general, results were very poor in the Indiana and Illinois area because the soil was dry and little precipitation occurred after planting of the corn and application of 2,4-D.

2. Post-emergence treatments on corn of as low as $\frac{1}{4}$ pound 2,4-D per acre may cause injury to the corn due to breaking of the brittle stalks in high wind.

3. Heavy applications of 2,4-D on the growing corn causes considerable lodging of the corn plants and a reduction in yield of corn.

4. Damage to both weeds and crop plants is greatest when plants are growing rapidly and is lessened by adverse growing conditions such as drought and cool weather--factors that prevailed over much of the area this past spring.

5. Both injury and stimulation of crop plants may result in the same plant population. Stahler emphasized that this undoubtedly is of common occurrence and that injury and stimulation probably result in a leveling off of yields of treated crops.

6. Varietal differences have shown up in corn but no outstanding differences have been observed in the effects on sweet corn, popcorn, and field corn.

7. Rarely have complete kills been obtained on thistle, bindweed, and other deep-rooted perennials with one application of 2,4-D, some re-treatment usually being necessary in the following and succeeding years. If good kills are obtained with the first treatment it may not pay to treat the following year and may be advisable to wait a year or two before re-treatment. Weak growth of these perennials in the year following application makes surviving plants especially tolerant to 2,4-D.

8. The ester formulations are in general more effective than the amine and sodium salts but also are most hazardous to crops and have the additional hazard of being volatile and subject to wind drift.

9. The amines are water soluble, next to the esters in effectiveness, and nonvolatile.

10. Rates of application that give fast kills of perennial herbaceous weeds usually do less harm to the underground roots, and the end results are poorer than where moderate rates of application are used.

11. Control of garlic with 2,4-D has not been very successful. Treatment must be early to be most effective.

12. Three-fourths of a pound of 2,4-D acid per acre is about optimum for bindweed control. This statement was generally agreed with by other members of the conference.

D. General Statements Contributed by Other Members.

1. Spraying oats with 2,4-D in the late boot stage will generally result in blasting of the lower florets.

2. Bond cross oats varieties have shown more injury from 2,4-D than other standard varieties.

3. In Wisconsin, where oats under-seeded with clover and alfalfa were treated in the early boot stage, clover is only slightly injured but alfalfa is generally injured. When 2,4-D is used on oats where legumes are seeded as a companion crop, a heavy growth of oats protects the legume seedlings. This practice is being widely adopted by farmers in Wisconsin.

4. Although 2,4-D is nonpoisonous to livestock, some carriers or diluents used in formulating 2,4-D may be poisonous. It was indicated that cattle prefer 2,4-D treated foliage, but no explanation of this preference was evolved.

5. Thirty to thirty-five pounds nozzle pressure per square inch was agreed to be most satisfactory in the application of 2,4-D.

6. Ammate (ammonium sulfamate), the most dependable general herbicide for woody plants, stumps, and stump sprouts, is unselective in action and will kill osage-orange and other woody species that are resistant to 2,4-D. The newer form of ammate carries a buffer that eliminates much of the corrosiveness associated with the older product.

7. An invitation was extended to the extension agronomists of the States in the North Central region to attend the North Central Weed Control Conference to be held at Springfield, Ill., on December 7, 8, and 9, 1948.

PERSONS PARTICIPATING IN CONFERENCE

Name	Specialty	Location
W. N. Bruce	Entomology	Illinois
G. C. Decker	Entomology	
M. E. Mansfield	Animal Pathology	
H. B. Petty	Entomology	
W. D. Scott	Agronomy	
H. K. Smith	Livestock Loss Prevention	
O. C. Lee	Weeds	Indiana
G. E. Lehker	Entomology	
Henry Mayo	Animal Husbandry	
H. B. Cheney	Agronomy	Iowa
H. Gunderson	Entomology	
E. P. Sylwester	Crop Pests	
E. G. Kelly	Entomology	Kansas
L. F. Taylor	Animal Husbandry	
L. E. Willoughby	Agronomy	
R. L. Janes	Entomology	Michigan
H. F. Moxley	Animal Husbandry	
L. V. Nelson	Agronomy	
Ralph Crim	Agronomy	Minnesota
W. E. Morris	Animal Husbandry	
H. L. Parten	Entomology	
Frank Dillard	Animal Husbandry	Missouri
Ross Fleetwood	Agronomy	
G. D. Jones	Entomology	
W. W. Derrick	Animal Husbandry	Nebraska
D. L. Gross	Agronomy	
C. A. Sooter	Entomology	
F. G. Butcher	Entomology	North Dakota
G. E. Strum	Animal Husbandry	
R. B. Widdifield	Agronomy	
L. K. Bear	Animal Husbandry	Ohio
D. F. Beard	Agronomy	
C. R. Neiswander	Entomology	
T. H. Parks	Entomology	
C. L. Iverson	Animal Husbandry	South Dakota
J. J. O'Connell	Animal Husbandry	
E. E. Sanderson	Agronomy	
H. C. Severin	Entomology	

T. C. Allen	Entomology	Wisconsin
G. M. Briggs	Agronomy	
J. J. Lacey	Animal Husbandry	
J. H. Lilly	Entomology	
W. A. Baker	Entomology	PISAE, USDA
F. C. Bishopp	Entomology	EPQ, USDA
O. S. Fisher	Agronomy	PISAE, Ext.,USDA
A. O. Foster	Animal Husbandry	BAI, USDA
Roy C. Jones	Dairy Husbandry	BDI, Ext.,USDA
Karl Knaus	Extension	Ext., USDA
E. F. Knipling	Entomology	EPQ, USDA
Karl S. Quisenberry	Agronomy	PISAE, USDA
L. M. Stahler	Agronomy	PISAE, (Brookings, S. Dak.)